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A Small Quantity Of Sodium Arsenite Will Kill Large Cull Hardwoods

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ALTHOUGH IT IS well known that sodium arsenite is an effective silvicide, forestry literature contains little information about the minimum quantities of this chemical that are required to kill large cull trees. Such information would be of value because if small quantities of a chemical will produce satisfactory results, small holes or frills in the tree will hold it; and the treatment will be less expensive in both labor and materials than other treatments that require more chemical and larger holes for its placement.

Among those who have reported using measured quantities of sodium arsenite solution are Lexen (2), who placed 25 cc of solution in each hole, spaced various distances apart; Pessin (3), who used about 6 cc in holes spaced 7 inches apart; and Curry et al (1), who used 9 cc in holes spaced 8 inches apart.

This information indicated the possibility that large northern hardwood trees might be killed with smaller quantities of sodium arsenite solution introduced into the tree at 8-inch intervals around the bole. To obtain more information about the efficacy of various quantities of sodium arsenite and ammate solutions for killing trees, an exploratory study was begun in July 1951 on the Paul Smith Experimental Forest in the Adirondacks.

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THE TREATMENTS

The two solutions were made with equal weights of dry commercial chemical and cold water. The solutions were placed in holes 7/16 inch in diameter, 2 inches deep, spaced 8 inches apart around each tree, and about 30 inches above the ground. The holes were bored with a carpenter's brace and bit.

The following dosages were used: sodium arsenite--2, 4, 10, and 14 cc; ammate--8, 16, 24, and 32 cc. Each dosage was tried on three trees each of beech (Fagus grandifolia), yellow birch (Betula alleghaniensis), and sugar maple (Acer saccharum). The same dosage was used in each hole in the tree. Larger quantities of ammate were used because a previous study (1) had shown that it was not so lethal as sodium arsenite when applied in this manner.

Measured quantities of the solutions were applied with a graduated hypodermic syringe. When more than 4 cc were required per hole, the doses were repeated at about 5-minute intervals. Rarely were the holes completely empty before being refilled, except that several of the 32-cc ammate treatments had to be completed the following day. The trees ranged from 8 to 29 inches d.b.h., averaging 14 inches. Although most trees would have been unmerchantable locally, they all had full, thrifty crowns.

EFFECT OF THE TREATMENTS

Frequent examinations were made to obtain information that might be useful for predicting final effects of similar treatments. The progress of crown mortality is shown in Figure 1. Most damage occurred within the first 2 months; after that, additional mortality occurred slowly up to the final examination in 1954, 3 years after treatment. By that time, the treatments with a minimum of 2 cc of sodium arsenite or 16 cc of ammate had damaged at least 90 percent of the beech and yellow birch crowns; damage by these dosages to sugar maple crowns averaged 83 percent for ammate and 80 percent for sodium arsenite.

Although the larger quantities of both chemicals caused severe crown damage, our interest was immediately focused upon the treatments with 2 cc of sodium arsenite--it would be easier to make wounds to hold this small quantity of solution.

DISCUSSION

It appears that 2 cc of sodium arsenite solution, applied as in this study at 8-inch intervals, may be the mini-

mum quantity that will kill large beech and sugar maple trees within 3 years. Since all yellow birch trees were killed within 1 year by the 2-cc dosage, it might be possible to kill this species with smaller quantities, but allowing a longer time--perhaps 2 or 3 years. (Some encouragement for this assumption was obtained from a preliminary analysis of another of our studies: it indicates that 1 cc of sodium arsenite solution, applied at 4-inch intervals, probably will produce results similar to 2 cc applied at 8-inch intervals.)

Early observations of the ammate treatments could not be used to predict subsequent crown damage. Severely damaged foliage dropped soon after the treatments were applied. However, some buds and branches were not killed and new foliage developed later. The maples treated with 8 cc of ammate reacted that way (fig. 1). The sodium arsenite treatments were more positive, and there was little evidence of crown recovery.

There appears to be no reason for concern about sprout development on treated trees. Basal sprouts increased in number until the second year following treatment, then some of them died. One year after treatment, 10 percent of the trees had live basal sprouts; 2 years after treatment 17 percent had live sprouts; 3 years after treatment only 10 percent had live sprouts. More of the sprouts will die as the area of dead cambium continues to extend farther below the point of application (this also occurred on northern hardwoods treated with a sodium arsenite solution in a frill (4)). Three years after treatment, half of the trees with live basal sprouts were sugar maple and the rest were beech. Among the five trees having completely dead crowns and live basal sprouts in 1954, two had been treated with ammate and three with sodium arsenite. Although sprouts did develop on two of the yellow birch, they died within 1 year and no live sprouts were present in 1954.

Where severe crown damage occurred soon after treatment (fig. 1), the chemicals initially killed wood and bark tissues in strips about 3 inches wide; these extended into the crowns and sometimes into the roots. The intervening live strips continued to die slowly. At the end of 3 years, the bark above ground was completely dead on 64 percent of the trees treated with ammate and on 86 percent of the trees treated with arsenite. This difference stems mostly from the sugar maples; with ammate the bark above ground was completely dead on less than half of them. This difference between chemicals was negligible on beech and birch.

Ambrosia beetles (Xyloterinus spp.) entered the trees soon after the bark had died (examinations were confined to

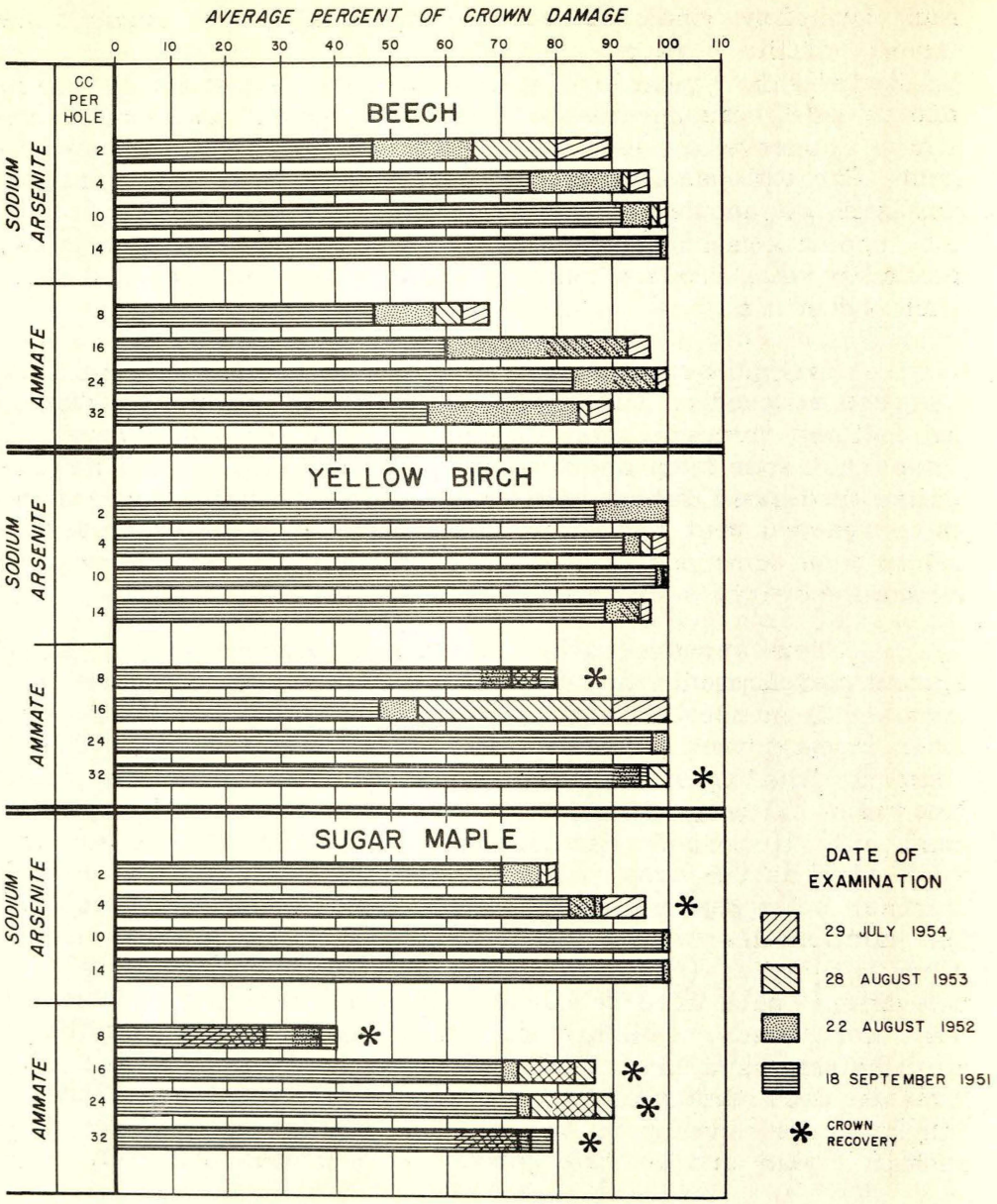

Figure 1.--Progress of crown mortality in northern hardwood trees treated with ammate and sodium arsenite.

the area within 6 feet of the ground). When not all the bark was killed, they entered only the dead strips. One year after treatment only 18 percent of the trees had escaped attack; 3 years after treatment only 7 percent remained uninfested. All except one tree in the latter group had been treated with ammate. Apparently the large areas of live bark made the trees unattractive to the beetles.

A ready-mixed commercial solution containing 40 percent of sodium arsenite probably would produce results comparable to those we obtained by using the half-and-half mixture of powder and water. Commercial solutions containing an animal repellent are recommended. It is desirable to study and practice safety precautions for handling sodium arsenite. They generally are found on the manufacturer's container. Additional precautions may be found in all literature cited.

There is evidence that, at least in the Adirondacks, summer treatments with sodium arsenite are better than winter treatments (1, 4). Results similar to those reported here for our July treatments probably could be obtained in the Northeast at any time from early June through August, and over a longer period in regions with longer growing seasons. Also, since excessive sap flow, which tends to flush out the chemicals, is one of the main troubles in early- or late-season treatment of maples, species that do not bleed so freely probably could be treated over a longer season (4). We have established additional studies to observe the efficacy of arsenite treatment at various seasons.

The results from this study demonstrate that large cull beech, yellow birch, and sugar maple can be killed, within 3 years, by placing 2 cc of sodium arsenite solution in holes spaced at 8-inch intervals around the tree. Although bored holes were used here for placement of the solutions, we have evidence from some of our other studies that single ax cuts will produce similar results. With 3 or 4 inches of undamaged bark between the edges of ax cuts, and applying 2 cc of solution in each cut, spacing and quantities are practically the same as with the bored holes. Research is continuing in an attempt to learn more about the problems involved in the development of an easily-applied and economical treatment suitable for stand-improvement work.

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